UNIVERSITÀ
POLITECNICA
DELLE MARCHE

SENSE-AI: diStributed intelligENt early warnIng SystEms for natural/Anthropic dIsasters

Supervisor: Professor Paola Pierleoni

Department of Department of Information Engineering
https://dii.univpm.it/en-gb/home/

UNIVERSITÀ POLITECNICA DELLE MARCHE

Supervisor: Professor Paola Pierleoni

Research Group Description: the Supervisor

Professor Paola Pierleoni

Associate Professor in Telecommunications, DII, UNIVPM,

Head of the RIoT Lab sensoR networks and Internet Of Things Laboratory

More than 121 peer-reviewed research articles with about 1900 citations https://orcid.org/0000-0002-1436-8864 (H-index = 27 according to Google Scholar; H-index = 24 according to Scopus). More than 29 years of experience in the field of Telecommunications Engineering.

Involved in several national and international projects.

- **"Energy-efficient Methods and enaBling technologies for communications, netwoRking, infrastructures and smArt services in Challenging Environments (EMBRACE),"** winner of the Cascade Call for Public and/or Private Entities within the **PE "RESTART - RESearch and innovation on future Telecommunications systems and networks, to make Italy more smART"** program.
- **"STREAM – Strategic development of flood management,"** part of the 2014-2020 Interreg V-A Italy - Croatia CBC Programme - Call for Proposal 2019, under Priority Axis: Safety and Resilience and Specific Objective: Increase the safety of the Programme area from natural and man-made disasters.
- "**International Research Center for the Science and Techniques of Physical, Economic, and Social Reconstruction – STRIC**," and "**Enhancement of the International Research Center for the Science and Techniques of Reconstruction – STRIC+**", funded under the National Recovery and Resilience Plan (PNRR).

UNIVERSITÀ POLITECNICA DELLE MARCHE

Supervisor: Professor Paola Pierleoni

Research Group Description

RIOT Lab – sensoR networks and Internet Of Things Laboratory

https://dii.univpm.it/riot_it/

***STAFF*: The group is currently formed by**

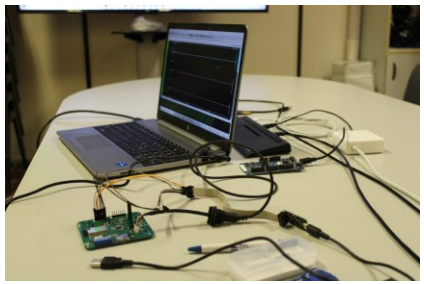
Prof. Paola Pierleoni
Prof. Lorenzo Palma
Dr. Alberto Belli
Dr. Sara Raggiunto
Dr. Luisiana Sabbatini
Dr. Marco Esposito
Dr. Sara Bruschi

RESEARCH TOPICS

- Wireless Sensor Networks
- Internet of Things
- Edge and Cloud Computing
- Federated Learning
- Early Warning Systems
- Distributed Artificial Intelligence
- Internet of Medical Things
- Indoor Localization Systems
- Bluetooth and Bluetooth Mesh
- 5G/6G

The RIoT Lab is a research facility in the Department of Information Engineering that serves students, PhD candidates, and researchers in Telecommunications and interdisciplinary fields.
Our work focuses on cutting-edge technologies, including Wireless Sensor Networks (WSN), the Internet of Things (IoT), Edge and Cloud Computing, Federated Learning, and Artificial Intelligence (AI), with applications in Early Warning Systems, the Internet of Medical Things (IoMT), and Industrial scenarios.

We collaborate with leading national and internation institutions and organizations in numerous fields, including the Italian National Consortium of Telecommunications (CNIT), the Italian National Geophysics and Volcanology Institute (INGV), the Civil Protection, the K.O.S. Group for elderly and rehabilitation care, Nordic Semiconductors, Mathworks Wireless Communications development team, the GARR (*Gruppo per l'Armonizzazione della Rete della Ricerca*) Consortium, the Divers Alert Network (DAN) Europe Research Division.



EQUIPMENT

- High-performance computing workstation (2 x 16-Core CPUs, V100 Tesla GPU, 320 GB RAM, 1.9 TB disk)
- NetSim network simulator
- Wearable devices (EMPATICA watch, 2M ballistocardiography equipment, NGIMU, etc.)
- Various sensors developed by the research group (analog and digital sensors for SHM and seismic monitoring, environmental and light monitoring sensors, wearable devices for Parkinson's disease monitoring, etc.)
- Single-board computers and hardware accelerators

RESEARCH AND PUBBLICATIONS

https://orcid.org/0000-0002-1436-8864
https://orcid.org/0000-0002-6142-0987

Department of Information Engineering – DII

Dean: Prof. Franco Chiaraluce

Department description

https://dii.univpm.it/en-gb/home/

The **Department of Information Engineering** (**DII**) was established in 2011 following the merge of the previous DIBET (Department of Biomedical, Electronics and Telecommunication engineering) and DIIGA (Department of Computer, Management and Automation engineering).

The Department is a self-managing organizational branch of the university dedicated to scientific research and teaching, and contributes to the so called Third Mission of the Higher Education Institution through the dissemination of scientific research findings amongst the community.

Its main aims are to plan, organize and regularly assess the quality of the research activities carried out in the scientific sectors and disciplines under its jurisdiction; to plan, organize and manage bachelor and master courses in Information Engineering and, last but not least, to provide cultural and educational activities and contribute to training and guidance issues according to the students' needs.

AT A GLANCE

DII  2024

250+ Publications

> 4 M€ Research income

71 Research staff

112 PhD, Post-doc, Research fellows

BACHELOR DEGREES:
Biomedical Engineering, Electronic Engineering and Digital Technologies, Computer and Automation Engineering, Information Engineering for Videogame and Virtual Reality.
MASTER DEGREES:
Biomedical Engineering (in English), Electronic Engineering, Computer and Automation Engineering.
BACHELOR DEGREE WITH PROFESSIONAL ORIENTATION:
Industrial and Information Systems.

DII coordinates the PhD in Information Engineering, organized in two curricula:
- Biomedical, Electronics, Telecommunication Engineering and Nanotechnologies (IBETN)
- Computer, Management and Automation Engineering (IIGA)

Research laboratories 32

11 Scientific Areas:
IINF-01/A, IINF-02/A, IINF-03/A, IINF-04/A, IINF-05/A, IBIO-01/A, IMIS-01/B, IIET-01/A, IEGE-01/A, MATH-06/A, ECON-04/A

UNIVERSITÀ POLITECNICA DELLE MARCHE

Supervisor: Professor Paola Pierleoni

Project Idea: SENSE-AI: diStributed intelligENt early warnIng SystEms for natural/Anthropic dIsasters

Backgroud: An Early Warning System (EWS) is a framework designed to monitor hazards, assess vulnerabilities, and issue timely alerts to reduce the impacts of disasters. Despite their proven effectiveness, EWS and multi-hazard EWSs remain limited globally, highlighting the need for advancements and disruptive innovations in disaster prediction, detection, and response systems. Technologies from the fields of telecommunications and information engineering—such as the Internet of Things (IoT), self-adaptive wireless sensor networks, low-cost sensing, and artificial intelligence (AI)—hold significant untapped potential to enhance EWS. Still, their use in this context remains underexplored and often limited by the challenging constraints of disaster scenarios, leaving a significant opportunity for innovation and improvement in global disaster management systems.

Project OBJECTIVES:

1. Implement distributed and edge computing solutions to reduce latency in disaster monitoring systems, enabling real-time analysis at the sensor and/or edge level.
2. Develop AI-aided, self-configuring wireless sensors networks that adapt and heal from failures or disruptions in communication.
3. Leverage advanced learning techniques, such as federated and self-supervised learning, to train distributed AI models across multiple edge devices or sensors without centralizing data.

Project OUTCOMES:

1. Enhanced decision-making speed during disaster events, improving response time and overall system efficiency.
2. More resilient and smarter monitoring networks able to enhance reliability and robustness in disaster-prone areas, ensuring continuous data flow and quality of service even in adverse conditions.
3. A distributed training framework for privacy-aware and continuous model improvements that adapt to each site condition.